COMMUNICATIONS CANADA

CENTRAL REGION

AUDIO DEVICES - INTERCEPTION OF RADIO SIGNALS

This package is intended to assist you with the problem of interception of radio signals by a record player, Hi-Fi or stereo amplifier, tape recorder, public address system, telephone or the audio section of a television or radio receiver where the condition is observed on all channels or all across the dial and in most cases the volume control has no effect upon the intensity of the signal. In the following discussion these units are referred to as "audio devices".

Audio devices are designed to amplify audio signals such as music or speech and are not intentionally designed or intended to function as receivers of radio signals. The Department cannot give any protection to audio devices which respond to signals from a nearby radio transmitting station as the problem is not caused by the improper operation or by technical deficiencies of the radio transmitter. Strong radio signal energy gains entry to the audio circuitry, "overloads" the amplifier, is "rectified" and amplified, and appears at the loudspeaker as undesired sound. Only modification of the audio device can "cure" the problem. You should, therefore, contact a qualified technician, the dealer, or the manufacturer of your audio device (or telephone company for telephone problems) for assistance. We have compiled the attached information which will assist in the correction of audio rectification and other related problems.

You may very reasonably ask, "Why do I have to do something to my audio device? It works fine except when the radio station is transmitting. Why is it my problem and not the responsibility of the operator of the radio station?" The answer lies in policies concerning the economics of the design and sale of these devices, in a highly competitive market. The device has two objectives: 1) to reproduce a desired audio signal and 2) to reject unwanted signals which may degrade the overall performance of the device, at a reasonable cost.

The state of the electronics art is such that it is possible to manufacture "custom built" audio devices; that is, to install in them complete shielding and special circuits to reject nearly all types of undesired signals. The cost of special designs and circuitry would necessitate an increase in the price of the device.

Perhaps less than one percent of the total number of audio devices in use today will be located near the strong field of a radio transmitting facility whereby the device will respond to radio signals which it is not designed or intended to receive. If it does, it requires the addition of filtering or shielding, or both.

Manufacturers believe it is unfair and unnecessary to burden the mass consumer market with the additional costs of special circuits and designs inasmuch as the number of devices affected is relatively small. Many manufacturers, dealers, and

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servicemen have devised procedures and processes to improve the radio signal rejection capability of audio devices and these modifications can be made when the need arises.

There are basically two situations which can arise and should be considered by the owners of such audio devices.

1. The owner may at present live in an area where his audio device is not exposed to strong unwanted radio signals and, therefore, the device works well. The situation may arise whereby the signal strength at the device is increased either by the establishment of a new station or by changes made to an existing nearby station. Now a problem occurs in that this audio device is now operating in the 1% category and will require modification to reject these unwanted signals.

2. The owner lived in an area where the audio device was not subjected to strong radio signals and, therefore, was not experiencing any problem. Now the owner moves to a new location and the audio device is subjected to a high level of unwanted signals. The device which previously had no requirement to reject these signals now is in such a position that it experiences operating problems. This audio device must be modified in order that it will be capable of rejecting these signals.

The information contained in this package is not necessarily widely distributed or fully recognized by all manufacturers, dealers and servicemen. The statement of a salesman or dealer that he sells a good quality device, or that there is nothing wrong with the unit, is not enough and avoids the issue. Persons in possession of an audio device not capable of rejecting radio signals must fully recognize the situation involved. An audio device may perform the task for which it was designed with excellence and still require special treatment to improve its capability to reject strong radio signals in some localities.

You are urged to bring this information to the attention of your servicemen, dealer, or manufacturer of your equipment.

SWAMPING INTERFERENCE

Record players, hi-fi and stereophonic amplifiers, tape recorders, electronic organs, public address systems, intercom systems, hearing aids and similar electronic devices are designed to amplify audio signals such as music and speech and are not intended to act as radio receivers.

Nevertheless, much of this equipment will act as a radio receiver, picking up strong signals from nearby radio or radar transmitters which are reproduced as interference. Such signals can originate from almost any kind of transmitting equipment ranging from high power radar units to passing police or taxi mobiles. Generally speaking, the higher the transmitter frequency, the higher its power and/or the closer it is, the greater the possibility of "swamping interference" being experienced by electronic devices such as mentioned above.

What happens in the presence of strong radio or radar signals is that some of the signal energy gains entry into the audio amplifier circuitry, overloads the amplifier, is then rectified and after being amplified, comes out of the loud speaker as interfering sound.

This "swamping interference" appears as interfering music or voices or in some cases as morse code or radioteletype. With radar transmitters the interference appears as a short "beep" or "buzz" every few seconds. Generally the volume control setting has little or no effect on the level of this type of interfering signal.

This form of interference can also be experienced in AM, FM, and TV receivers and manifests itself by the fact that changes in the tuning dial or channel selector have no effect on the interference. Similarly, changes in the volume control setting have little or no effect.

The incidence of this type of interference is increasing because:

a) there has been a tremendous increase in the amount of electronic equipment of this type being used by industry, business, and in the average household.

b) of the increased use of solid state (transistorized) equipment.

While this form of interference can and is experienced on vacuum tube type equipment, solid state circuitry is more susceptible because of the fact that transistors are more inclined to overload on strong signals. Also, the printed circuit techniques now so commonly used often have little or no shielding, thus permitting direct pick-up of strong radio or radar signals.

It must be emphasized that when such interference is experienced, the fault lies with the amplifier itself (or other devices containing an amplifier) and all methods applied to effect a cure must be applied the amplifier itself. There is nothing that can be done at the transmitter short of it ceasing operation.

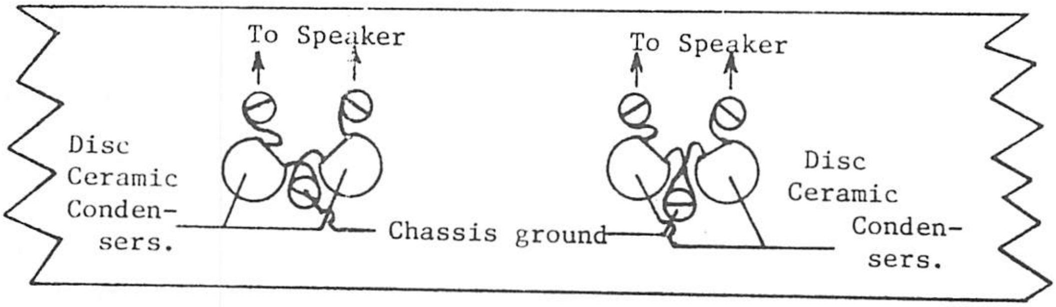
SOME SUGGESTED CURES

1.0 The most common entry point of strong radio or radar signals into an amplifier system is via the loudspeaker leads. This is because most good quality amplifiers have a feedback loop which couples a portion of the audio output signal back to the earlier stages to provide some degeneration for improved frequency response. Thus any signals picked up on the loudspeaker leads will find an easy path of entry to the early stages of the amplifier.

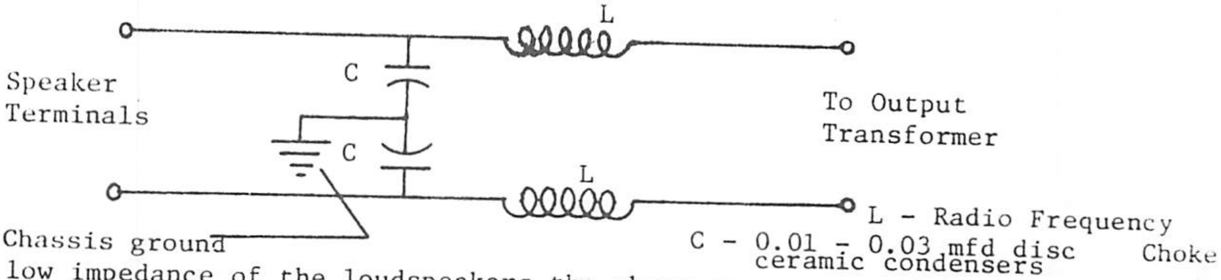
1.1 Recommended cures for the above are:

(i) Replace the speaker leads with shielded wire, grounding the outside metallic braid to the amplifier chassis.

(ii) By-pass the loudspeaker leads to the amplifier chassis using 0.01 mfd to 0.03 mfd disc ceramic condensers. Keep all leads as short as possible.



(iii) Another method used by some manufacturers consists of a filter network installed under the amplifier chassis between the speaker terminals and the output transformer. This filter consists of two condensers as in (ii) above plus two small radio frequency chokes. The latter can be made up by close winding 24 turns of number 18 solid enamelled wire on a ¼ inch diameter form (a pencil will do). Keep all leads as short as possible.


L
C
Speaker Terminals
C
L
To Output Transformer
Chassis ground
L - Radio Frequency Choke
C - 0.01 - 0.03 mfd disc ceramic condensers

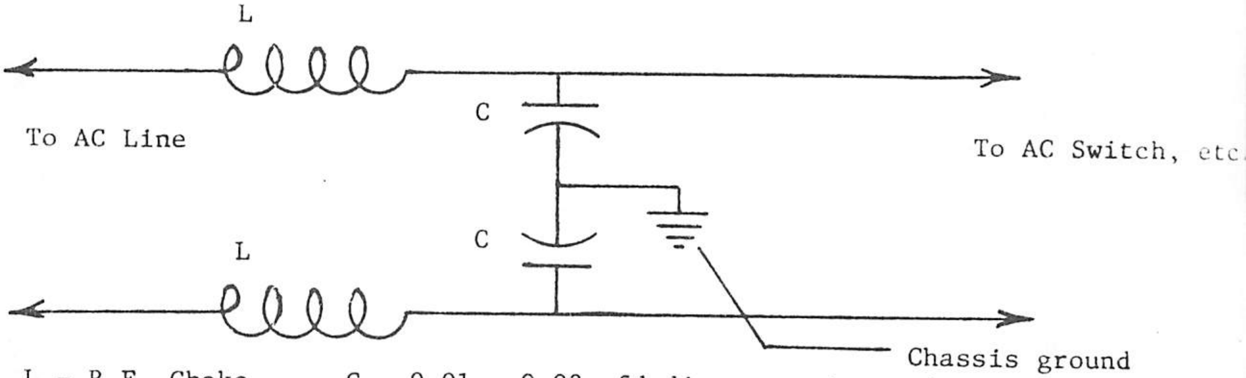
1.2 With the low impedance of the loudspeakers the above components will not affect frequency response of the amplifier.

2.0 In many instances strong signals gain entry via the powerline. This can be prevented by:

(i) installing 0.01 to 0.03 mfd disc ceramic condensers from each side of the AC line to chassis ground where the line enters the chassis.

(ii) installing a 0.01 mfd disc ceramic condenser across the high voltage power supply output filter condenser.

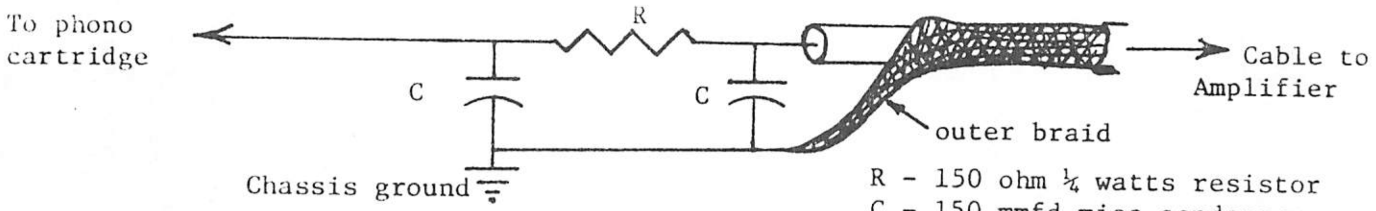
2.1 In extreme cases a filter network similar to that in paragraph 1.1(iii) may be necessary as shown below. These chokes can be made up by close winding 24 turns of number 16 enamelled wire on a 3/8 inch diameter form.



L - R.F. Choke C - 0.01 - 0.03 mfd disc ceramic condensers

Again, keep all leads as short as possible.

3.0 Some turntable phono arms use a short length of unshielded wire from the cartridge to terminals in the base of the turntable chassis where it connects to a shielded cable running to the amplifier input. This is an ideal entry point for strong radio or radar signals. Where possible this unshielded wire should be replaced by special light-weight shielded wire made specially for this purpose. If the added weight of this shielded wire upsets the phono arm tracking force, the only alternative is to insert a filter at the tie point referred to above. This consists of two mica condensers and one resistor. In the case of stereophonic pick-ups a filter will be required in each lead.

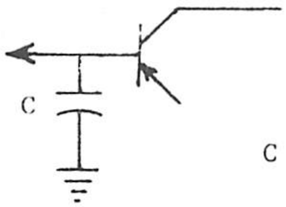


R - 150 ohm ¼ watts resistor
C - 150 mmfd mica condensers

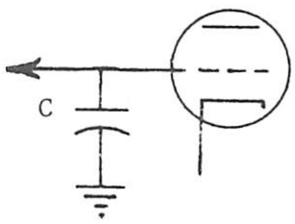
4.0 With component type installations all units including the turntable chassis should be bonded together using braided type metal flex. Do not rely on the shielding of interconnecting cables to provide good bonding. If possible connect the installation to a good ground (such as a water pipe).

5.0 If the interference persists after applying the above cures, it may be necessary to apply filtering across the input of the first transistor stage (or grid of the first vacuum tube). This consists of a 100 to 250 mmfd mica condenser connected from the base of the transistor to chassis ground (figure a) below) or, in the case of a vacuum tube type amplifier, from the grid to chassis ground on the first tube (figure b) below). Keep all leads as short as possible.

a)



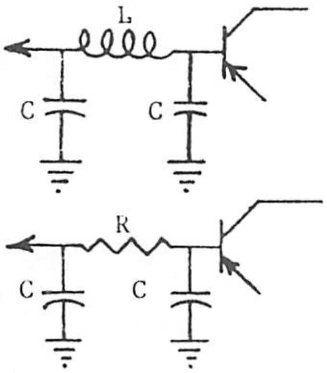
b)



C - 100 - 250 mmfd mica condenser

5.1 In extreme cases a small radio frequency choke or a 50,000 - 75,000 ohm resistor and a second condenser may be reuqired as follows.

a)

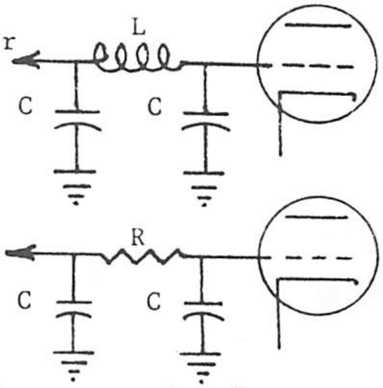


C - 100 - 250 mmfd mica condenser

R - 50,000 to 75,000 ohm ¼ watt resistor

L - Radio Frequency Choke, same dimensions as in para 1.1 (iii)

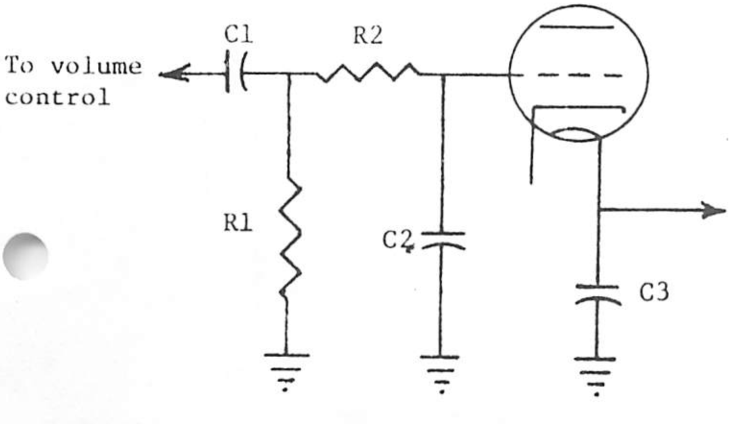
b)



5.2 In particularly stubborn cases the approach shown in paragraphs 5.0 and 5.1 above may have to be applied to the next amplifier stage or even to all the remaining stages.

6.0 Tube type radio and television sets, particularly the AC/DC variety, often use grid leak biasing on the first audio amplifier stage. The grid resistor in such cases is generally in the order of 5 to 10 megohms, which places the grid so high above ground it is very prone to overloading by strong radio or radar signals. A suggested modification is shown below.

1st Audio Stage



C1 - 0.01 mfd paper or ceramic condenser
C2 - 100 - 250 mmfd mica condenser
C3 - 0.001 mfd ceramic condenser on AC/DC sets
R1 - 2 megohm ¼ watt resistor
R2 - 50,000 to 75,000 ohm resistor

7.0 There have been instances where replacing a missing tube shield has eliminated a direct signal pick-up problem and cured this type of interference. In another case the installation of a shield over the input amplifier tube cured the problem. In the latter case the unit, as distributed by the namufacturer, did not use any tube shields.

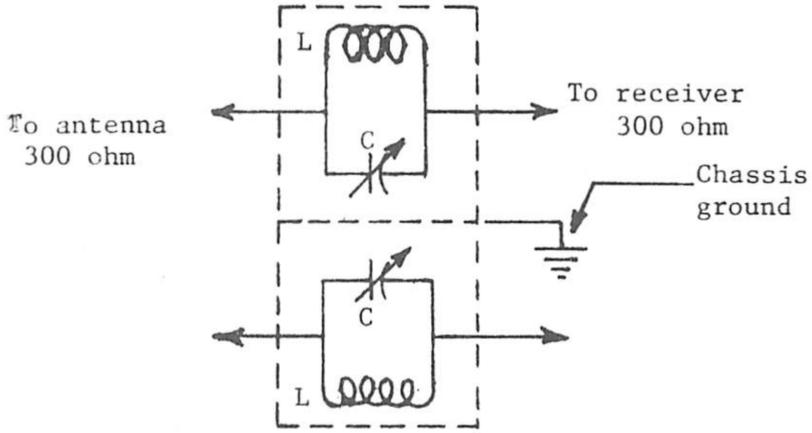
7.1 Some cases may require the addition of a metal bottom plate under the amplifier chassis and/or a cover over the chassis. Most amplifiers generate quite a bit of heat and consideration must be given to the need for adequate ventilation when applying any form of shielding. Ordinary copper fly screening is an excellent form of shielding material and provides minimim imparement of ventilation.

8.0 On some AM/FM stereophonic receivers, FM receivers, TV sets and combination units, strong radio or radar signals may gain entry into the chassis via the antenna circuit and eventually find their way into the audio circuitry to produce interference.

8.1 Disconnecting the antenna lead will prove whether or not it is the pick-up source. If this is found to be the case, the cure is to filter these signals out before they enter the chassis as follows:

a) If the interfering signal is below 50 MHZ, connect a high pass filter in the antenna lead. Several models are commercially available.

b) Connect parallel traps in the antenna feed line, these being tuned to the frequency of the interfering signal.



Values of L & C are chosen to resonate at frequency to be rejected. These circuits should be installed i a small metal box and each LC network must b isolated from the othe

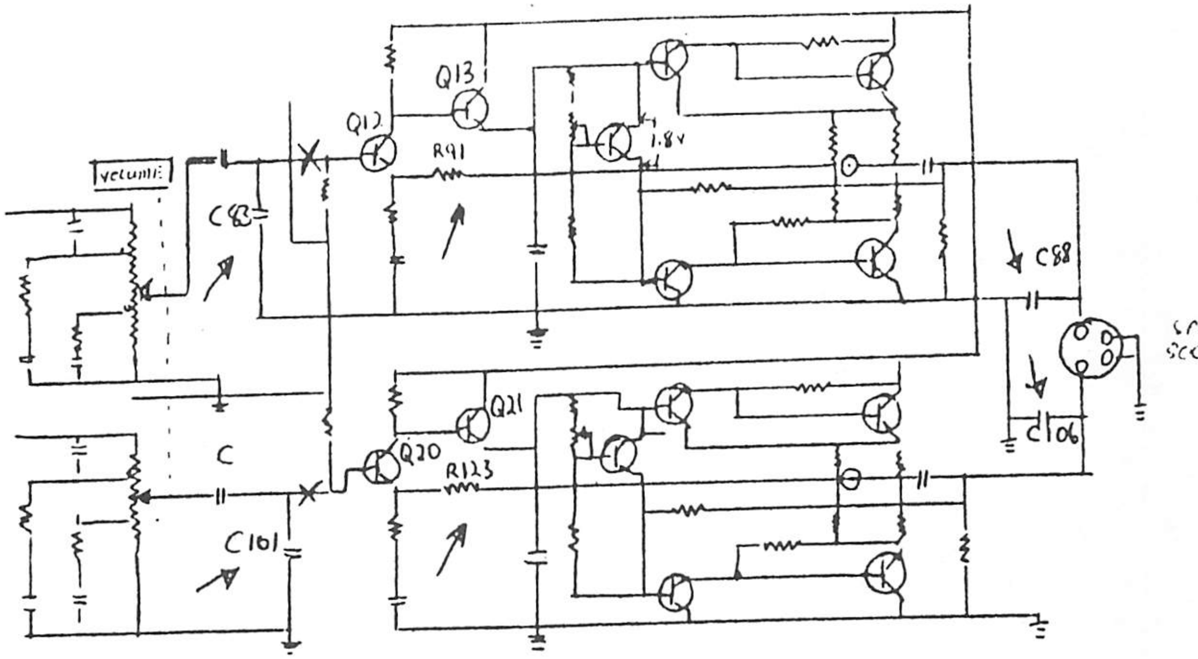
c) Connect a quarter wave stub tuned to the frequency of the interfering signal across the antenna terminals. A copy of SII-13-54 outlining the construction of such stubs in the range 40 to 220 MHZ is attached.

9.0 Sets have been encountered where the interfering signal was fairly weak but on placing one's hand near or on the volume control, the interference increased greatly in level. Investigation revealed that the volume control shaft was insulated from the ground and was actually serving as the pick-up point. The cure here is to replace the volume control with one whose shaft is grounded.

10.0 Basically the approach to curing this type of interference is to find out how the signal is being picked up or where it is gaining entry into the amplifier and then eliminate its pick-up or entry by the addition of shielding or filters as outlined above. As a word of caution to the layman, it is strongly recommended that work of this type only be undertaken by experienced electronic technicians.

SUPRESSION TECHNIQUES FOR A TYPICAL SOLID STATE AUDIO AMPLIFIER CIRCUIT

Although there is no sure cure that will work in all cases, any one or combination of the following approaches will help to minimize or eliminate the receiption of unwanted radio signals.



1. Add 1000 uufd capacitors from both speaker leads to ground. (See C88 and C106)
2. Add 100 uufd capacitors from both bases of the input transistors to ground. (See C83 and C101)
3. Remove both parallel negative feedback capacitors if used. (Not used above. Normally they would be connected across R91 and R123.)
4. Add 1K capacitors from both phono input jacks to ground providing the set uses a ceramic or crystal cartridge. (Not shown above)
5. Add 1K resistors in series with both audio input circuits at points intersected with an "X" above.
6. If interfering signal is above 100 MHz, adding ferrite beads to the signal input leads of the driver transistors (Q12-13 and Q20-21) is an effective measure.
7. Ground the speaker frames by connecting them directly to the black speaker leads.